CONCEPT STORMWATER MANAGEMENT REPORT

for

PROPOSED HOLIDAY PARK DEVELOPMENT

3540 THE LAKES WAY CHAROLTTE BAY

LOT 110 IN DP 1091944

Prepared by

TATTERSALL LANDER PTY LTD

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Document Information

Version	Prepared By	Qualification	Date
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1.0 INTRODUCTION

This report has been prepared to support a Concept Application for a holiday park development proposed for 3540 The Lakes Way, Charlotte Bay (Lot 110 in DP 1091944).

Figure 1: Locality Diagram

2.0 BACKGROUND INFORMATION

The most obvious feature of the site in general is the existing golf course layout that has been created to the north-west and the north-east of the proposed development footprint. This area is outside the proposed development footprint and is not the subject of this report, other than the fact stormwater will discharge onto these lands from the proposed development.

The development footprint portion of the site has a mixed history – the majority of the site is vegetated in some form, with various areas of clearing for access tracks, sheds and other vegetation disturbances associated with the use of the property. While generally maintaining tree canopy coverage, the understorey is generally cleared and currently generally consists of grassland. There is evidence onsite of livestock grazing, as well as a cleared corridor from a former road reserve and electricity transmission line. There are also several historical stockpiles onsite of unknown origins, understood to be related to the previous golf course construction activities.

3.0 SITE CONTEXT

The site is zoned RU2 Rural Landscape, and has frontage to The Lakes Way for its full western boundary.

The majority of the property (eastern and southern sections) is either ecologically or topographically constrained, and will not form part of this application. A golf course layout has been constructed adjoining the development area to the north and east.

Within the proposed development footprint, the topography is best described as gently sloping. There is a defined crest through the centre of the development footprint, and drainage flow paths from the proposed development will fall to the floodplain either side of this crest.

Levels generally range from 13.0m AHD in the south-west of the development area, to around 4.0m AHD and below in the surrounding floodplain. The development area is mostly vegetated, with mature forest trees and maintained grassed understorey. There are some disturbed areas within the development footprint, related to current landuse practices (access tracks, earthworks and stockpiling areas), and what appears to be a former road reserve and electrical transmission line.

Review of the Regional Geotech Solutions Land Rezoning report (RGS00460.1-AC, January 2013) shows the soils within the current development area to be silty clay topsoil overlaying a high plasticity clay colluvial soil.

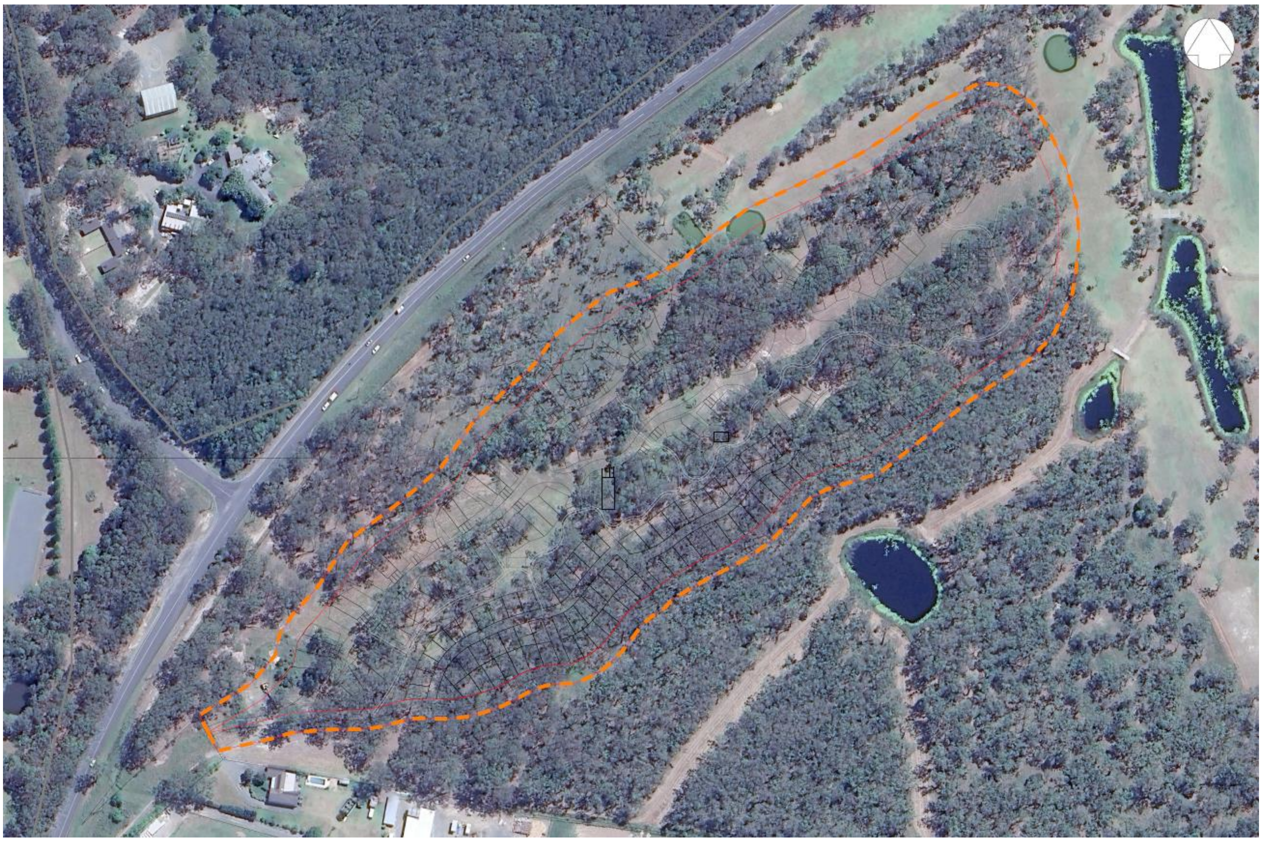


Figure 2: Site Aerial Image

Photo 1: Existing Site

Photo 2: Existing Site

Photo 3: Existing Site

Photo 4: Existing Site

Photo 5: Existing Site

4.0 PROPOSED DEVELOPMENT

It is proposed to construct a holiday park on a north-western portion of the property. The proposal will include: -

1. Minor bulk earthworks,
2. 200 sites, comprising;
   - 70 camping sites
   - 130 short term sites
3. Community facilities,
4. Roads and drainage,
5. Other associated infrastructure,

A proposed layout plan can be seen below.

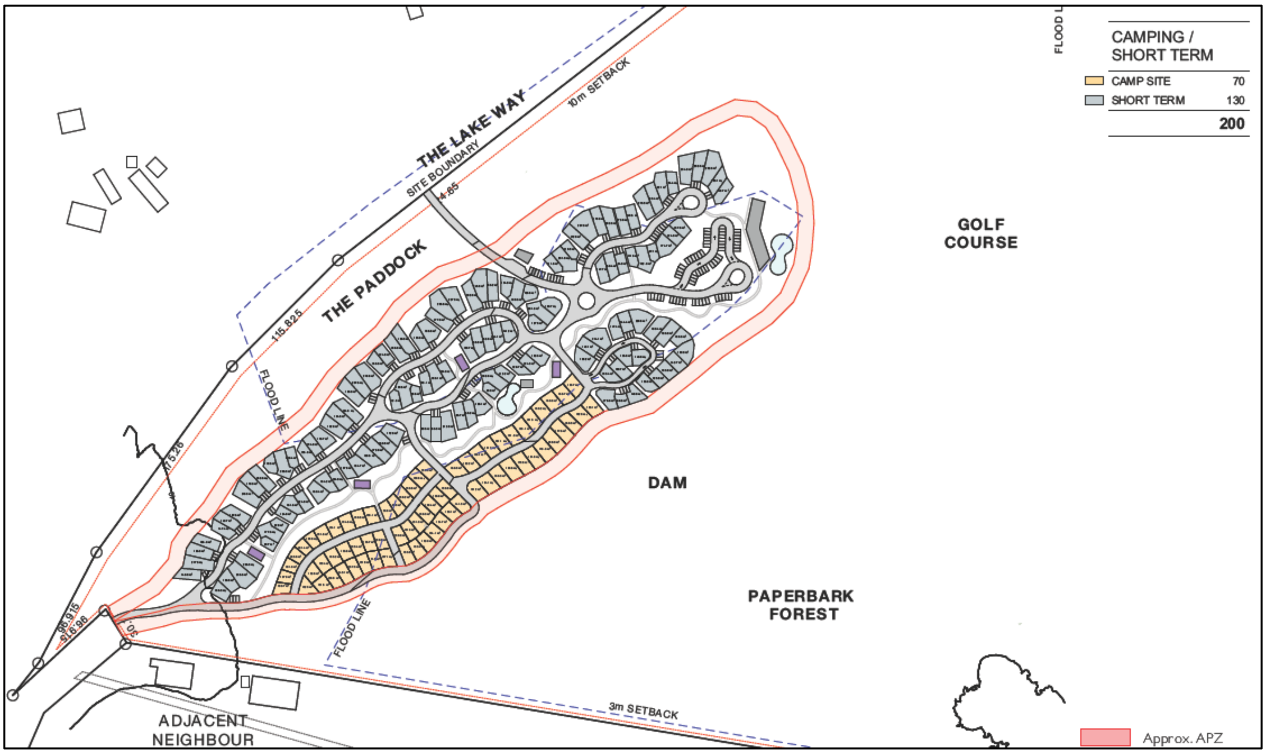


Figure 3: Proposed Development

While this application does not specifically propose cabin/dwelling construction, it is acknowledged that cabins may be installed on any of the short-term sites at a future date. In order to give a holistic view of the possible ultimate development scenario, these possible future cabins have been included in the modelling of this report.

5.0 WATER QUALITY TARGETS

As a site >2,500sq.m with less than 10% existing impervious surface, the Water Sensitive Design section of the Great Lakes Council Development Control Plan states that a water quality treatment train for this development should meet the pollution reduction targets in Table 1 below:

Table 1: Stormwater Quality Targets

Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	Neutral or Beneficial Effect (NorBE)
Total Phosphorus (TP)	Neutral or Beneficial Effect (NorBE)
Total Nitrogen (TN)	Neutral or Beneficial Effect (NorBE)

6.0 CONSTRAINTS AND OPPORTUNITIES / BEST PLANNING PRACTICES

Drainage and water quality considerations have been key considerations in the planning process, with stormwater detention and biofiltration areas (Council's preferred device) included through the concept design process.

The existing undeveloped (pervious) and mostly undisturbed vegetated nature of the site will result in relatively low target pre-development pollutant levels.

Existing clay soils across the development area mean infiltrating treatment and disposal methods will not be suitable, and any stormwater assets will need designed to achieve free drainage to surface drainage paths, and to be clear of groundwater impacts.

A flood report has been completed for the site by EMM Consulting, and the 1% AEP 2100 Flood Level has been determined to be around 4.7m AHD in the proximity of the development footprint. The resulting Flood Planning Level would be 5.2m AHD. While the central rise through the development area is above this level, various portions of the proposed development footprint are not, including some parts of the bushfire Asset Protection Zone, some access roads and some of the short term and camping sites.

The extent of this regional flooding presents some challenges regarding the location of stormwater infrastructure. The proposed development footprint means that raingardens and any detention facilities will need to be located below the regional flood extents. It is understood that Council will permit water treatment devices below the regional 1% flood level, but the functionality of any detention infrastructure may be affected by regional flows and/or have impact on these regional flows. Detaining development stormwater in areas that would otherwise act as regional flood storage would potentially worsen the regional flood effects, which are the critical stormwater event impacting downstream infrastructure. As such, it is not proposed to construct development-scale detention facilities.

A post-developed scenario has been modelled by EMM Consulting that exclude the use of any detention structures, and this model confirms that the impacts on upstream and downstream properties and infrastructure is negligible.

Review of previous geotechnical assessment of the site (Regional Geotech Solutions, 2013) predicted groundwater to be between 3.0m and 4.0m AHD across the development area, although it is noted that the observations for this assessment were during an extended dry period and water levels may be closer to the surface in wetter periods.

The desired nature of the development requires retention of significant portions of existing vegetation. As such, the design concept proposes a 'light touch' layout what will require a more small-scale distributed approach to treatment and detention where possible, taking advantage of the existing slopes draining the site towards the floodplain for stormwater treatment and disposal.

As a relatively low impact, low density proposal, conceptually it is envisaged that drainage will generally not be concentrated into a pit and pipe network unless where absolutely necessary. Roads would be constructed without kerbs or pits and would shed directly onto the adjacent pervious areas, and roof water will initially be intercepted by rainwater tanks before overflowing to an adjacent dispersion trench. Collection and concentration of flows would only occur at the edge of the development footprint to allow for treatment and detention before discharge into the surrounding ecological lands and golf course.

7.0 SOIL AND WATER MANAGEMENT

A critical time for increase pollutant loads is during construction, and with this in mind, current practice recommends guidelines from Landcom's "Blue Book". Erosion and sediment control measures should be designed and specified in accordance with the "Blue Book" guidelines, and to Council's satisfaction, and be inspected and maintained during the construction phase. This will assist in ensuring adherence to pollutant prevention measures, particularly the removal of suspended solids (sediment).

It is understood that while testing was undertaken some years ago for the Soil Landscapes of the Bulahdelah / Forster, the resulting mapping has never been published. The NSW Government's eSPADE tool shows that the closest of these sampling spots was taken approximately 1km to the north of the proposed development site. 'Profile 424' reports show a top layer of Loamy Sand at the site, and reports the Erosion Hazard as 'slight'.

As the construction footprint will be in excess of 2,500sq.m, typically it would be expected that a detailed Soil and Water Management Plan would need to be prepared for construction prior to release of the Subdivision Works Certificate. This would normally include calculations of likely soil loss during construction, instructions on preferred construction sequence and limiting land disturbance, and calculations for the provision and sizing of any temporary sedimentation basin to cover the period of civil works.

The following RUSLE calculation has been prepared as an initial assessment of the proposal (references are to "The Blue Book" – Managing Urban Stormwater, Landcom, 2004);

ARR87 2-yr 6hr Intensity = 12.61mm/hr	(former GLC Engineering Dept)
R = 3440	(Eq 2 App A)
K = 0.05	(eSPADE mapping)
LS = 1.19 (5% Slope for 80m)	(Tab A1 App A)
P = 1.3	(Tab A2 App A)
C = 1.0 (bare earth during construction)	

The resulting computed soil loss is therefore calculated as 205m^3/ha/yr, or 530m^3/yr for the proposed development disturbance footprint (assuming the whole site is disturbed / constructed at once).

The Blue Book has a trigger at 150 m^3/yr, above which construction sedimentation basin(s) would be required during the future construction works (S6.3.2 (d)). It is recommended that once the development proposal has been refined and any staging determined, this assessment should be reassessed on a stage-by-stage basis.

8.0 INTEGRATED WATER CYCLE MANAGEMENT

It is expected that all community facilities and short-term sites will be serviced with reticulated water and sewer connected to the MidCoast Water Services network.

BASIX is not technically applicable in a tourist park. However, to decrease the development's demand on potable water and also in line with WSUD principles, roof water runoff from the proposed community buildings and any future cabins installed on short term sites is to be directed into rainwater tanks for reuse onsite (toilet, laundry and external landscaping uses).

There is no recycled water service to the site.

9.0 STORMWATER MANAGEMENT - HYDROLOGY

9.1 FLOODING

A flood report has been completed for the site by EMM Consulting, and the 1% AEP 2100 Flood Level has been determined to be around 4.7m AHD in the proximity of the development footprint. The resulting Flood Planning Level would be 5.2m AHD. While the central rise through the development area is above this level, various portions of the proposed development footprint are not, including some parts of the bushfire Asset Protection Zone, some access roads and some of the short term and camping sites. Under the Local Government (Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings) Regulation, camping site and short terms sites are permissible in flood affected areas with approval from Council.

It is understood that the flooding impacts in the development area are generally a result of stormwater afflux from waters backed-up by the catchment discharge control under The Lakes Way. As such, floodwaters are expected to rise relatively slowly and have minimal velocities, inundating the golf course area first before rising onto the lower sections of the proposed development area. Safe evacuation from these flood-affected areas to other areas of the development footprint is easily available.

Any permanent structures, such as The Homestead, the camping amenities buildings and the Administration Building, should be built with a finished floor level above the Flood Planning Level for the site.

9.2 DRAINAGE

The nature of urban development is that it increases the amount of impervious surface in a catchment, which in turn can decrease runoff times and create higher peak flow rates. It is important with new developments that these impacts are considered with relation to the potential impacts on surrounding properties. Often detention measures are required to be put in place to prevent increases in peak runoff rates from the site.

The density and style of this particular development only equates to a maximum 25% Total Impervious Area within the development area (assuming cabins are built on all short-term sites), and the development site itself is part of a significantly larger overall catchment generally planned to remain undeveloped. There are no directly adjacent properties that may be impacted, but downstream structures such as the culverts under The Lakes Way should be considered when determining the need for detention.

Detaining development stormwater in areas that would otherwise act as regional flood storage would potentially worsen the regional flood effects, which are the critical stormwater event impacting downstream infrastructure. Given the style of development, and its size, scale and position within the overall catchment, it is not proposed to construct development-scale detention facilities.

A post-developed scenario has been modelled by EMM Consulting, which confirms that the impacts on upstream and downstream properties and infrastructure is negligible.

10.0 STORMWATER MANAGEMENT – WATER QUALITY MODEL

10.1 BACKGROUND

The quality of runoff generated by the site is important to ensure the preservation of the downstream environments as an increased proportion of impervious area can lead to a subsequent increase in the quantities of suspended solids, phosphorus and nitrogen exiting the site in stormwater runoff. Runoff from this site flows through the second and third order streams in the adjacent golf course, before making its way into Wallis Creek and ultimately Charlotte Bay at the very top end of the Wallis Lake. It is understood that this section of the lake is particularly sensitive to changes in water quality, as it is naturally a warmer, more shallow area of the lake that does not receive much tidal flush due to its location.

The aim of this section of the study is to determine what measures can reasonably be undertaken as part of this development towards meeting the water quality objectives set out in Table 1 in Section 5 of this report.

10.2 MUSIC MODELLING

MUSIC is the Model for Urban Stormwater Improvement Conceptualisation, developed by the Cooperative Research Centre for Catchment Hydrology. MUSIC provides the ability to model both quality and quantity of runoff generated by catchments. Therefore MUSIC can simulate annual stormwater volumes, and expected annual pollutant loadings.

MUSIC is designed to model stormwater runoff systems in urban catchments. It is used to simulate a range of temporal and spatial scales. Catchment modelling can be performed for areas up to 100 km^2, with times steps from 6 minutes to 24 hours to match the range of spatial scale. This enables long term modelling of continuous historical rainfall data from pluviograph sources, and reflects the ability to account for temporal variation in data for an annual rainfall series directly.

MUSIC also has the ability to model a number of treatment devices, and measure their effectiveness in terms of the quantity and quality of runoff downstream. This allows determination of the degree of reduction in annual pollutant loadings.

It is important to note that the MUSIC simulation relies heavily on input variables and MUSIC models can be calibrated to local conditions. However, for the scale of most urban development projects, it is generally considered unreasonable to perform a calibration and input parameters can be sourced from various guidelines, such as Council's WSD Guideline or the current NSW MUSIC Modelling Guidelines.

10.2.1 CLIMATE / RAINFALL

To accurately model a site of this size, continuous rainfall record spanning at least five years with a six-minute timestep is required. MidCoast Council have prepared a template for use across the LGA and this template has been utilised to create the model for this report.

The rainfall record in the template is ten years of data between the dates of 1/1/1969 and 31/12/1978. This data produced a mean annual rainfall of 1234mm. It is noted that the long-term average rainfall (obtained from the Bureau of Meteorology) for Nelson Bay (approximately 50km from the site) is 1348mm, and 1218mm at Forster (20km from the site).

10.2.2 EVAPORATION

To accurately model the outcome of water quality treatment measures, potential evapotranspiration (PET) data is required. Again, this data has been taken from the MidCoast Council template which has a mean annual value of 1367mm.

10.2.3 NODE PARAMETERS

The MUSIC model was used to simulate the pollutant export generated during a ten-year period of average rainfall. Rainfall-runoff parameters for Type D soils were adopted from Section 4.6.5 of the Midcoast Council Guidelines for Water Sensitive Design Strategies (2019). Typical pollutant concentrations were derived from the NSW MUSIC Modelling Guidelines (2015). The adopted parameters can be seen below.

An Impervious Rainfall Threshold of 0.5mm/day was adopted for the “Roof” nodes and 1.5mm/day for all other nodes, per Council’s guidelines.

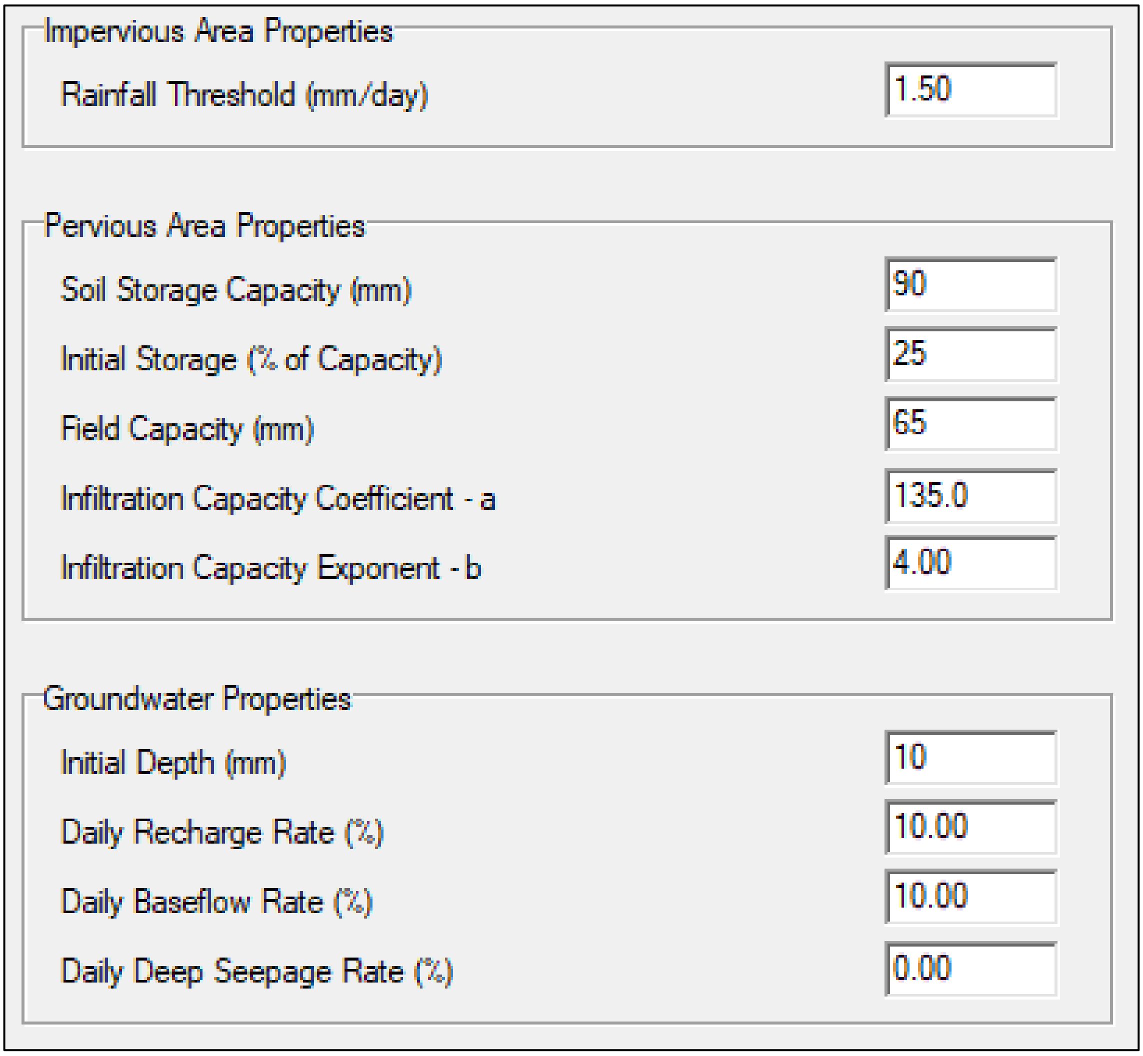


Figure 4: Adopted Rainfall-Runoff MUSIC Parameters

Table 2: Adopted MUSIC Pollutant Generation Parameters

	Rural Residential	Re-vegetated	Forest	Roof	Urban Pervious
Baseflow TSS Mean (mg/L)	14	14	6	-	15.8
Stormflow TSS Mean (mg/L)	90	90	40	20	140
Baseflow TP Mean (mg/L)	0.06	0.06	0.06	-	0.14
Stormflow TP Mean (mg/L)	0.22	0.22	0.08	0.13	0.25
Baseflow TN Mean (mg/L)	0.9	0.9	0.3	-	1.3
Stormflow TN Mean (mg/L)	2	2	0.9	2	2

10.2.4 EXISTING FLOW & POLLUTANT ANALYSIS

The existing site was modelled to simulate the current pollutant loads from the site. The vegetated portions of the site have been modelled as a Forest node with zero percentage impervious, which best represents the existing landuse. The portions of the site that have been cleared / disturbed have been modelled as a rural landuse with zero percent impervious.

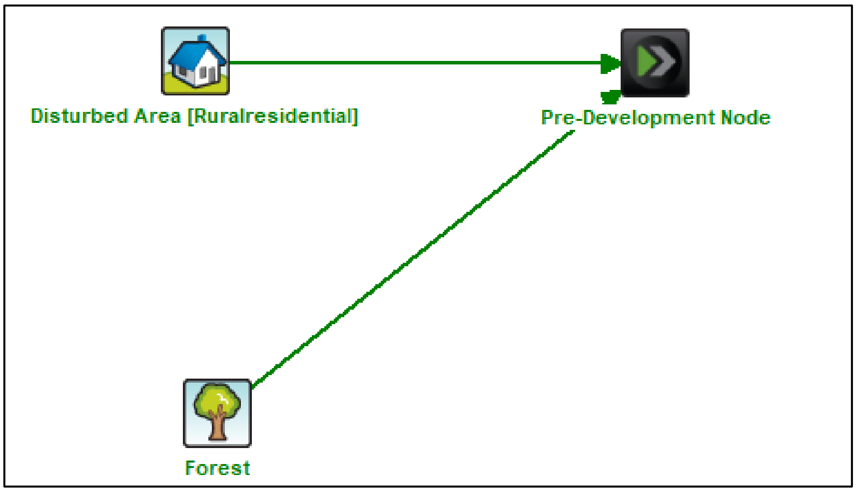


Figure 5: Existing State MUSIC Model

10.2.5 PROPOSED DEVELOPMENT FLOW & POLLUTANT ANALYSIS

The proposed development was modelled to determine expected pollutant loads and the effectiveness of the proposed water treatment measures. Conceptually, it is envisaged that drainage will not be concentrated into a pit and pipe network unless where absolutely necessary – roads would be constructed without kerbs or pits and would shed directly onto the adjacent pervious areas. Roof water will initially be intercepted by rainwater tanks before overflowing to an adjacent dispersion trench.

The only reason for collecting / concentrating water is to direct regular rainfall into the constructed treatment areas before it leaves the development area. For this purpose, it is proposed to construct grassed swales around the perimeter of the development in the APZ. Because some of these swales will range from 0.5% to 6.0% gradient (which is outside Council's 2-5% requirement for water treatment), these swales have not been included in the MUSIC modelling. It is expected, however, that there will be some additional unquantified treatment in these structures.

As described above, it is intended to generally utilise a combination of rainwater tanks and bioretention raingardens to provide the bulk of the treatment. There is a portion of the development footprint however, that sits comparatively low and will not provide adequate height relief to implement a bioretention strategy. Shown separately as 'Catchment 1', this area will be drained via surface swale drains to the area shown as "The Paddock". To create effective drainage, there will likely require some localised areas of minor regrading / filling (<0.5m) in this area for construction of the access road and some short term sites.

The two catchments described above were broken up into different areas depending on the surface type, including;

- Roof areas from community building structures (measured directly off the architectural plans), modelled as "Roof" nodes with 100% impervious area;
- Roof areas from prospective future cabins on short term sites (assumed at 50sq.m per site), modelled as "Roof" nodes with 100% impervious area;

- All access road areas (measured directly off the architectural plans) were modelled as a “Residential” landuse with 100% impervious area;
- Biofiltration areas (including the landscaped batters into the biofilters) have been included as a separate source node with a “re-vegetated” landuse as it is not accurate to include them as an urban landuse. These areas are 100% pervious, have complete native vegetation coverage, and would experience none of the pollutant generating activities typical of urban lands (lawn clippings, fertilisation, dog droppings, deciduous leaf-fall etc).
- Perimeter bushfire APZ maintenance buffer area modelled as a ‘rural’ landuse,
- Remaining urban pervious areas were modelled as a residential node with 0% imperviousness. This area represents the short-term site areas not covered by a cabin roof, the camping sites, the open spaces around the various community facilities and grassed and landscaped areas.

Modelled treatment nodes include;

- **Rainwater Tanks –** A total of 30kl of combined storage for the (or 5kl each on each of the four camping amenity buildings + 10kl at The Homestead), and 2kl tanks on each short-term site for cabin roof area. It has been assumed that 100% of the roof areas from these structures will be connected to the tanks. It is expected that captured water from these tanks will be used onsite in toilet, laundry and external uses only.

  Sensitivity tests and a discussion on tank size is included in Appendix D. It is also considered that these 2kl is a realistic minimum tank size, and would not preclude the use of larger tanks if desired by the park operators. In reality, the roof areas contribute such a small component of the overall pollutant loads that the tank volumes and reuse rates are largely insignificance to the overall results.

It is noted that tanks are only required on short term sites if a permanent cabin structure is installed - sites utilised for caravans / camping do not require tanks.

For the tanks on the short-term sites, Council have reviewed water usage data from similar facilities in their LGA and have advised that a usage rate of 0.1kl/day/cabin should be adopted for facilities such as this. While park operators may utilise this water for landscape maintenance of the short-term sites, there is no data available on this and external uses have been set to zero.

For the tanks attached to the camping amenity buildings, based on the MidCoast Water Services Equivalent Tenements Policy rate of 0.5ET/toilet, in total the community facilities would equate to 10ET, or equivalent to 10 standard dwellings – i.e. equivalent internal reuse rates for 10x55L/day was adopted from the Council WSD Guidelines. External reuse may be extensive if utilised for maintaining landscaping adjacent to these structures, but there is no real reliable guidance on what the average external reuse rate may be, so a rate of 36kL/yr/ET (distributed by PET minus Rain) was adopted as the lower value from the Council and NSW MUSIC modelling guidelines.

- **Vegetated Buffer –** with the internal roads intended to drain directly to the adjacent pervious areas, 'vegetated buffer' treatment nodes have been included to represent the filtering of pollutants this achieves.

- **Biofiltration Systems –** biofiltration areas have been designed for treatment of all runoff from the development area (other than 'Catchment 1', as described below). Conceptually these will need to be distributed across the site as terrain and vegetation constraints dictate. A total of 2285sq.m filter area 0.2m detention depth and a 0.4m filter depth have been modelled. The orthophosphate content of the filter media has been modelled at 40mg/kg.

  Sensitivity testing of the filter area has been undertaken and is detailed in Appendix D – while under sizing the filter area will result in bypass of pollutants through the system, oversizing them may result in system failure if there is not enough water supply to support the plantings through dry periods. In this instance there is no clear-cut point of diminishing returns, and a filter area of 3% of the contributing catchment area has been adopted as a best-fit. This is consistent with previous Council advice.

The base will be lined with a saturated zone provided to help support plant life through dry periods. Underdrain discharge will be piped to the nearest available point of relief, which in most cases is an existing adjacent dam structure.

Overflows will be dispersed as surface flows to the adjacent golf course and ecological areas.

The RGS geotechnical report found groundwater at the site was around 3.0-3.2m AHD, which will only just be clear of the base of the submerged zones, but as this is isolated by an impermeable liner, even in significantly wet periods the groundwater should not interact with the raingardens or effect their operation.

Grassed Swales – As described above, the ‘Catchment 1’ area adjacent to “The Paddock’ is not sufficiently elevated to incorporate biofiltration. This area will be filled / regraded as necessary to achieve effective surface drainage via grassed swales - a minimum 2% longitudinal grade is required by Council for these swales to ensure effective maintenance. A base width of 1m and 4(H):1(V) side slopes have been adopted. A total length of 205m of swales have been measured from design plans within ‘Catchment 1’. Another 950m of perimeter swales have conservatively not been included in the model as they may be less than 2% or more than 5% in longitudinal grade.

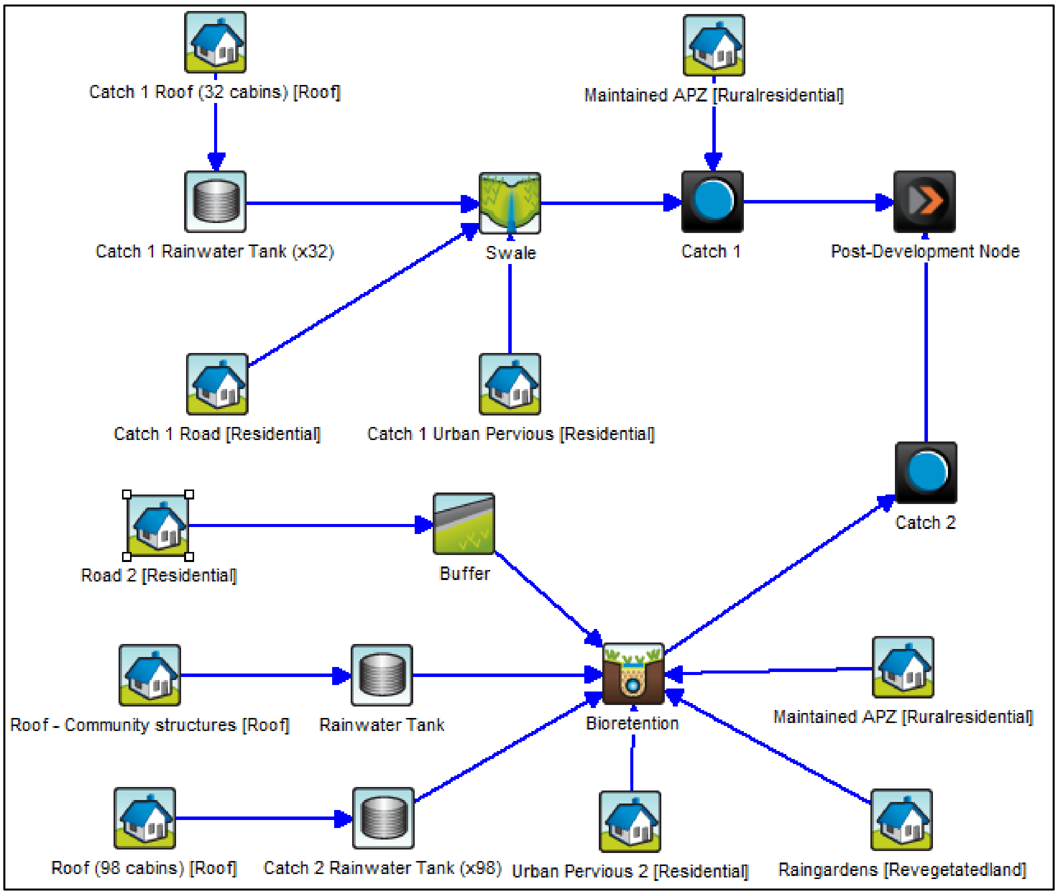


Figure 6: Proposed Development MUSIC Model

10.2.6 COMPARISON OF POLLUTANT RESULTS

Pre and post development pollutant loads are presented in the table below, to compare results to the required targets.

Table 3: Comparison of Pre and Post-Development Pollutant Loads

	Pre-Developed	Post-Developed	Treatment Train % Reduction	NorBE Compliant
TSS (kg/yr)	3700	637	92.2%	Yes
TP (kg/yr)	4.99	4.41	70%	Yes
TN (kg/yr)	50.0	48.5	59.8%	Yes
GP (kg/yr)	0	0	100%	-

* NorBE = Neutral or Beneficial Effect

11.0 COSTS

All stormwater infrastructure will be installed by the developer and will remain in private ownership for the life of the development. As no costs are to be incurred by Council, a detailed analysis has not been provided in this report.

12.0 OPERATION AND MAINTENANCE PLAN

Regular minor maintenance is required to ensure water treatment measures continue to operate in an effective way. These tasks should be performed every three months or after heavy storm events, but the flat nature of the site and sandy soil type means minimal sedimentation of the biofilter area is expected once the site is finalised.

Many of these tasks would be considered ‘instinctive’ every-day maintenance activities for park maintenance staff with minimal associated costs, such as watering the plants during dry periods, weeding and clearing blockages of inlet and outlet structures.

The maintenance schedule in Appendix C has been prepared as a typical template to direct grounds maintenance staff undertaking routine maintenance, and is based on Raingardens and Bioretention Tree Pits Maintenance Plan Example prepared by the Facility for Advancing Water Biofiltration, Monash University. Relevant sections have been reproduced and/or modified for the specific site conditions.

All biofilter maintenance activities will need to commence as soon as biofilters are planted and brought online and continue for the life of the development.

13.0 CONCLUSIONS

The tourist park has been designed with drainage and water quality constraints in mind, and the current proposal represents a design that balances the constraints of the site and the development outcome.

Flooding – Parts of the development footprint are impacted by the 1% flood level, and all permanent community facilities should have floor levels at or above the 5.2m FPL. The camping sites and short-term sites located below the 1% flood level are allowable under the Local Government (Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings) Regulation with Council approval.

Drainage - In keeping with the existing site hydrology, the development has been designed to drain with minimal stormwater interception – roads will shed to adjacent pervious areas wherever possible, and roof area runoff will be initially intercepted by rainwater tanks before overflowing to adjacent permeable areas. Runoff will generally be captured before it leaves the development area and directed into bioretention structures proposed at various low points around the outside of the footprint.

Due to the nature, size and scale of the development within the broader catchment, there should be no discernible impacts on neighbouring properties or public infrastructure as a result of the development, and internally within the site there is adequate provision for the functionality, safety and amenity of the facility.

Water Quality - Stormwater runoff quality has been addressed on-site via a treatment train that includes the construction of a dispersed biofiltration raingarden network across the site, provision of a total of 30kl of tank storage attached to the community buildings, and a commitment to a minimum 2kL rainwater tank with any future cabin installations. The modelling results indicate that this treatment train has been optimised to give the best long term results and the DCP Neutral or Beneficial Effect water quality targets can be met for this proposal.

14.0 REFERENCES

Geotechnical Assessment – Proposed Land Rezoning, January 2013, RGS00460.1-AC, Regional Geotechnical Solutions

Guidelines for Water Sensitive Design Strategies, October 2019, Midcoast Council & Alluvium

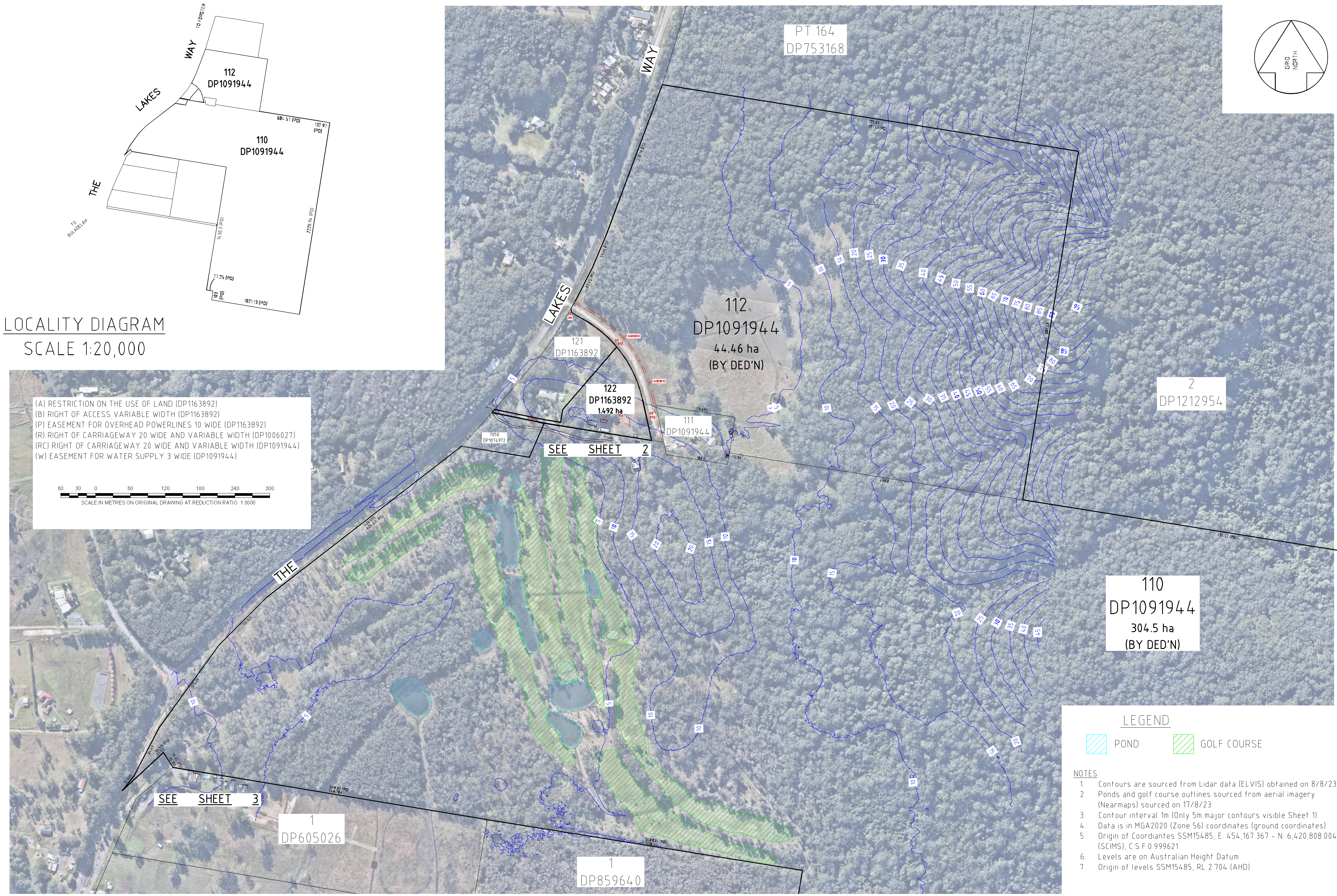
MUSIC Version 6.0 User Manual, 2011, eWater

MUSIC Modelling Guidelines, 2018, Healthy Land and Water Limited & Water By Design

NSW MUSIC Modelling Guidelines, 2015, BMT WBM

WSUD Engineering Procedures: Stormwater, 2005, Melbourne Water

APPENDIX A: SITE DETAIL SURVEY



(A) RESTRICTION ON THE USE OF LAND (DP1163892)
(B) RIGHT OF ACCESS VARIABLE WIDTH (DP1163892)
(P) EASEMENT FOR OVERHEAD POWERLINES 10 WIDE (DP1163892)
(R) RIGHT OF CARRIAGEWAY 20 WIDE AND VARIABLE WIDTH (DP1006027)
(RC) RIGHT OF CARRIAGEWAY 20 WIDE AND VARIABLE WIDTH (DP1091944)
(W) EASEMENT FOR WATER SUPPLY 3 WIDE (DP1091944)

60 30 0 60 120 180 240 300
SCALE IN METRES ON ORIGINAL DRAWING AT REDUCTION RATIO 1:3000

LEGEND

POND   GOLF COURSE

NOTES:

1. Contours are sourced from Lidar data (ELVIS) obtained on 8/8/23
2. Ponds and golf course outlines sourced from aerial imagery (Nearmaps) sourced on 17/8/23
3. Contour interval 1m (Only 5m major contours visible Sheet 1)
4. Data is in MGA2020 (Zone 56) coordinates (ground coordinates)
5. Origin of Coordiantes SSM15485, E: 454,167.367 - N: 6,420,808.004 (SCIMS), C.S.F.0.999621
6. Levels are on Australian Height Datum
7. Origin of levels SSM15485, RL 2.704 (AHD)

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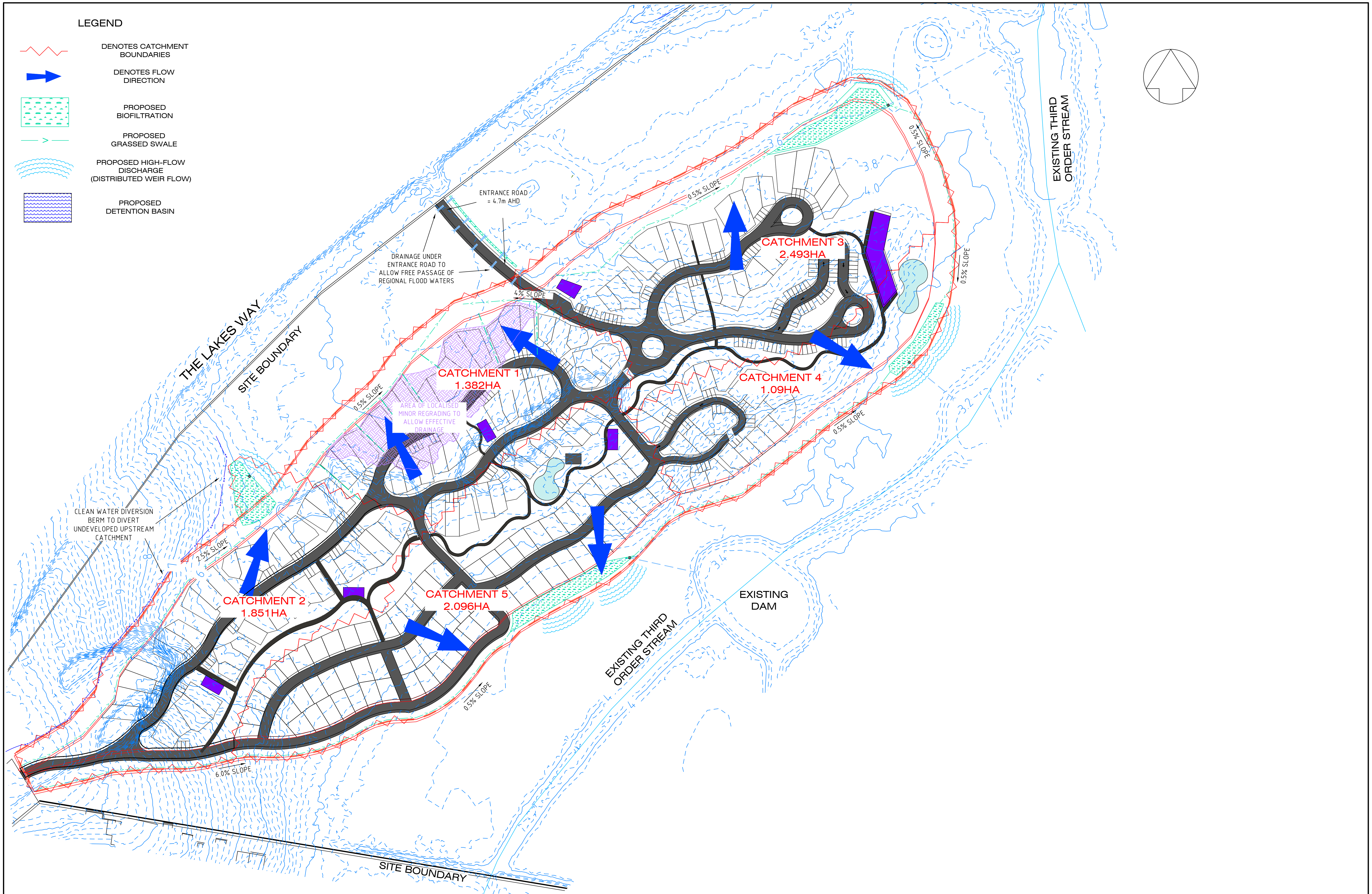
CONTOUR PLAN OVER LOTS 110 AND 112 IN DP1091944,
AND LOT 122 IN DP1163892
3540 & 3656 THE LAKES WAY, CHARLOTTE BAY

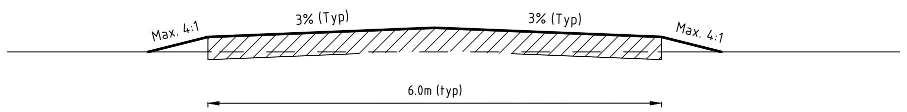
COUNCIL: MID-COAST	REFERENCE: 223172
PARISH: FORSTER	SHEET SIZE: A1
SCALE: 3,000	SHEET No.: 1 of 3
DATE: Plotted 23/8/23 12:07PM	

RB	BL	22/8/23	
CHECKED	APPROVED	DATE	

CLIENT: LANDS ADVISORY SERVICES PTY LTD | JOB No.: 223172 | COMPUTER FILE : S:\Clients\2023\223172\Dwg\223172_TOPO.dwg

APPENDIX B: PROPOSED LAYOUT & DETAIL PLANS





ACCESS ROAD TYPICAL CROSS SECTION

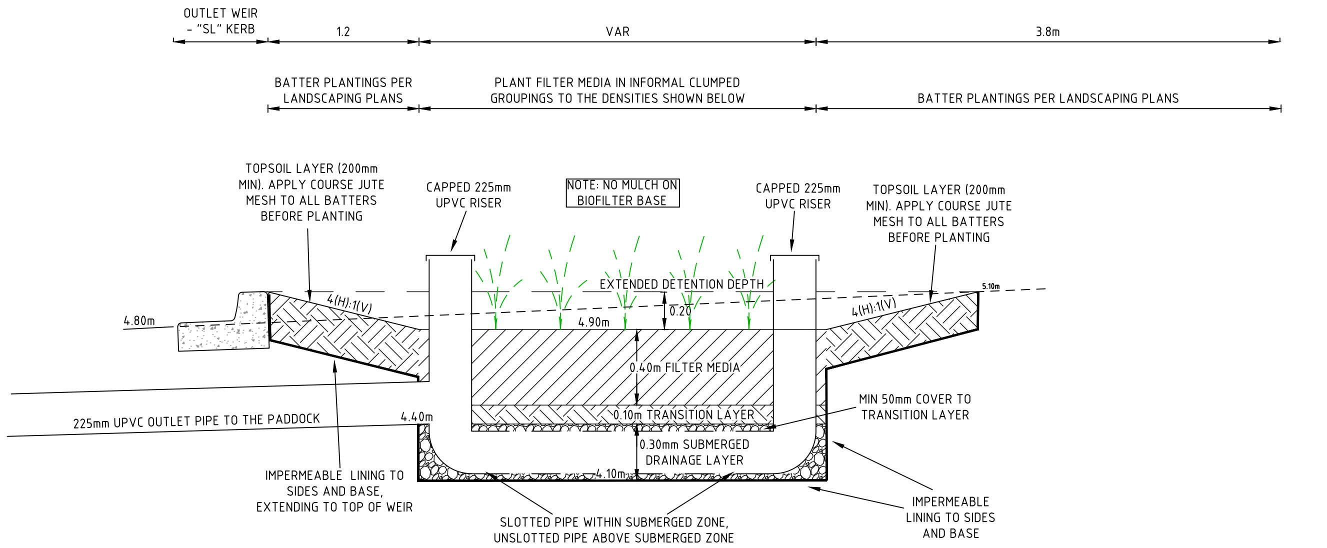
REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					

TATTERSALL LANDER PTY LTD
DEVELOPMENT CONSULTANTS
ENGINEERING, SURVEYING & PLANNING
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
(02) 49871500 reception@tatland.com.au

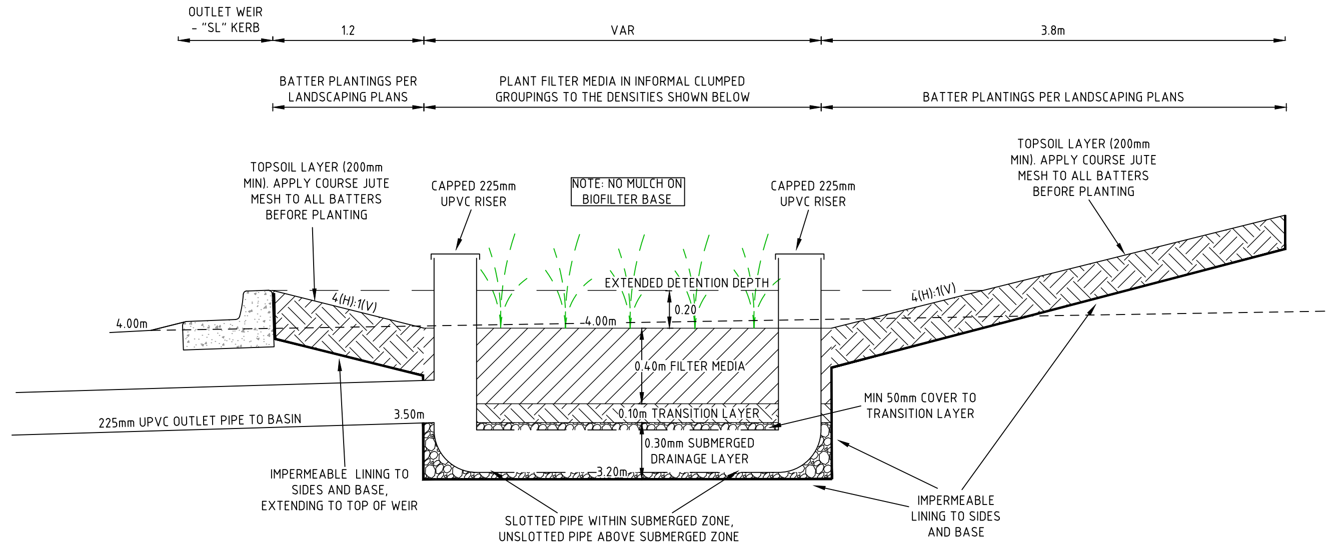
CONCEPT STORMWATER PLAN
'BLUEY'S ESTATE'
LOT 110 DP 1091944, 3540 THE LAKES WAY
CHARLOTTE BAY

COUNCIL: MIDCOAST
REFERENCE:
PARISH:
SHEET SIZE: A3
SCALE:
SHEET No.: of
DATE: Plotted 30/9/24 4:38PM
CLIENT:
JOB No.:
COMPUTER FILE : S:\Clients\2023\223172\Dwg\223172 Planning.dwg

Xref: Architects Layout [Architects Layout.dwg]



TYPICAL RAINGARDEN 2 DETAIL
NOT TO SCALE



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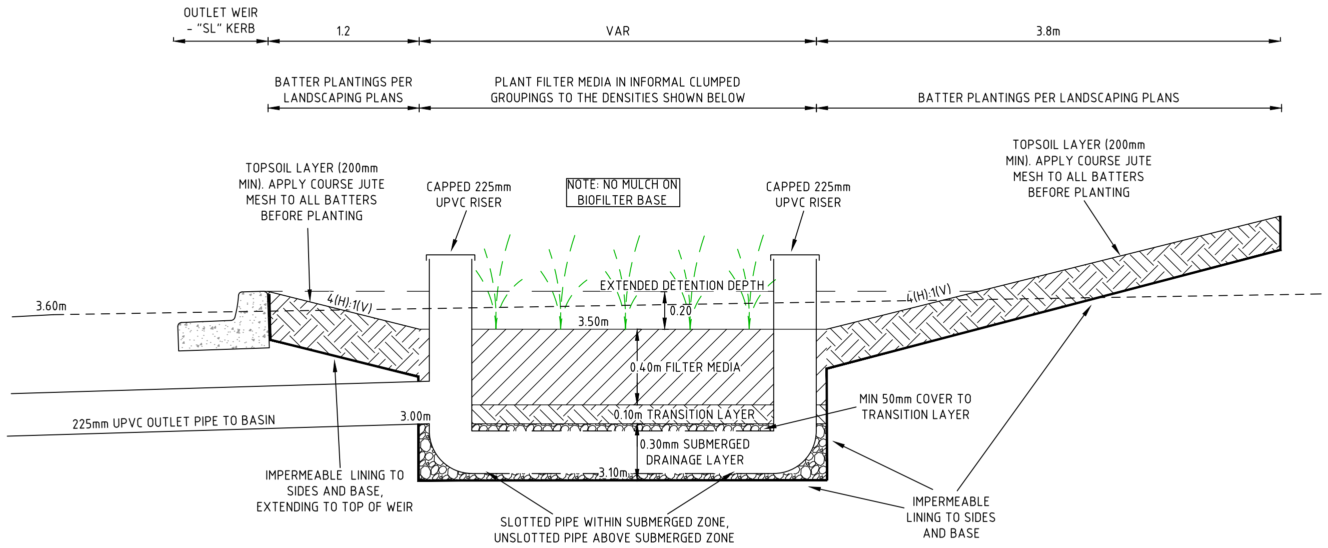
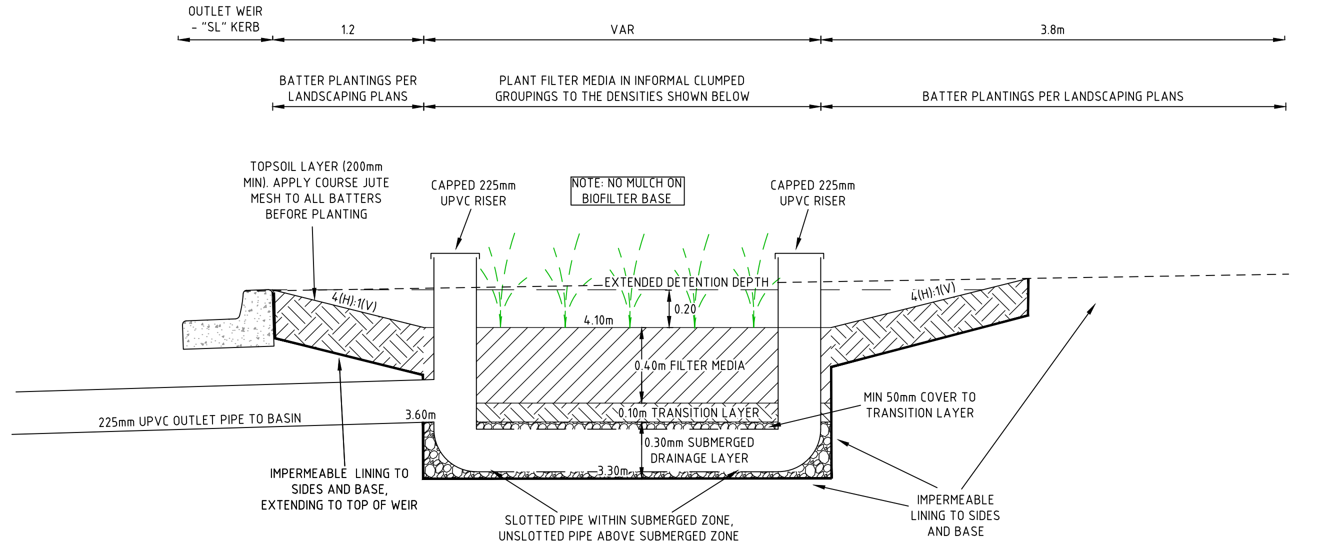


TYPICAL RAINGARDEN 3 DETAIL
NOT TO SCALE



TYPICAL RAINGARDEN 5 DETAIL
NOT TO SCALE

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					

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CONCEPT STORMWATER PLAN
'BLUEY'S ESTATE'
LOT 110 DP 1091944, 3540 THE LAKES WAY
CHARLOTTE BAY

COUNCIL: MIDCOAST
REFERENCE
PARISH
SHEET SIZE: A3
SCALE
SHEET No. of
DATE: Plotted 30/9/24 4:03PM
CLIENT:
JOB No.:
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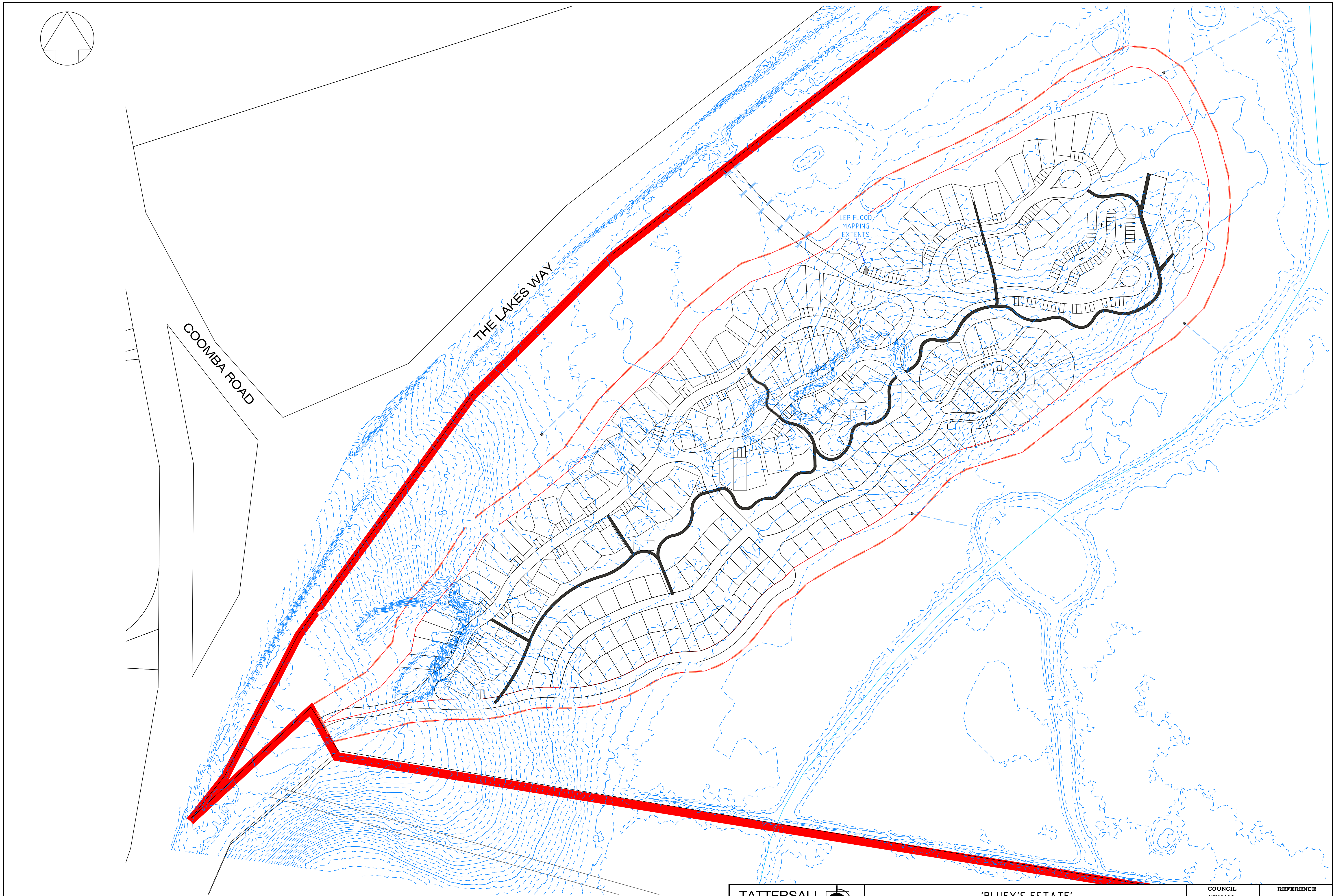

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					

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RAYMOND TERRACE 2324
(02) 49871500 reception@tatland.com.au

'BLUEY'S ESTATE'
LOT 110 DP 1091944
3540 THE LAKES WAY
CHARLOTTE BAY

COUNCIL MIDCOAST	REFERENCE		
PARISH	SHEET SIZE	A3	
SCALE	SHEET No. of		
DATE: Plotted 30/9/24 4:05PM			

CLIENT: JOB No.: COMPUTER FILE : S:\Clients\2023\223172\Dwg\223172 Planning.dwg

0 10 20m
(1:2000 for A3 Size Plot)

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					

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(02) 49871500 reception@tatland.com.au

'BLUEY'S ESTATE'
LOT 110 DP 1091944
3540 THE LAKES WAY
CHARLOTTE BAY

COUNCIL	REFERENCE
PARISH	SHEET SIZE: A1
SCALE 1:2000 on A3	SHEET No. of
DATE: Plotted 30/9/24 4:05PM	

CLIENT: | JOB No.: | COMPUTER FILE : S:\Clients\2023\223172\Dwg\223172 Planning.dwg

APPENDIX C: BIOFILTER MAINTENANCE TASKS

A. Filter Media Tasks

Sediment Deposition	Remove sediment build up from the surface of bioretention swales Frequency – 3 monthly after rain
Holes or scour	Infill any holes in the filter media. Check for erosion or scour and repair, provide energy dissipation (rocks & pebbles etc) if necessary Frequency – 3 monthly after rain
Filter media surface porosity	Inspect for the accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. A symptom may be that water remains ponded in the swale for more than a few hours after a rain event. Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media between plants Frequency – 3 monthly after rain
Litter Control	Check for litter (including organic litter) in and around bioretention swales. Remove both organic and anthropogenic litter to ensure flow paths and infiltration through the filter media are not hindered. Frequency – 3 monthly after rain

B. Horticultural Tasks

Pests and Diseases	Assess plants for disease, pest infection, stunted growth or senescent plants. Treat or replace as necessary. Reduced plant density reduces pollutant removal and infiltration performance Frequency – 3 monthly after rain
Maintain original plant densities	Inspect condition of all plants. Replace and dead plants immediately to maintain a minimum density of 4 plants per square metre Frequency – 3 monthly after rain
Drought / Extreme Heat	In periods of prolonged drought or extreme heat, the condition of plantings and site lawn coverage should to be monitored for signs of stress. Watering may be required to ensure plant survival Frequency – As required

Weeds	It is important to identify the presence of any rapidly spreading weeds as they occur. The presence of such weeds can reduce dominate species distributions and diminish aesthetics. Weed species can also compromise the systems long term performance. Inspect for and manually remove weed species. Application of herbicide should be limited to a wand or restrictive spot spraying due to the fact that the swales are directly connected to the stormwater system Frequency – 3 monthly after rain
Grassed buffer strip	Grassed buffer strips treat runoff as it flows off the roads, before it enters the bioretention swales. Maintaining a healthy grass cover is important, but the use of fertilisers should be kept to a minimum given their proximity to the drainage network
Lawn Fertiliser	Healthy site grass coverage is important for pollutant treatment, topsoil erosion control and aesthetics. However, if not correctly used, fertilisers can damage the downstream environment. A low Phosphorus fertiliser with restricted leaching properties such as a Fused Calcium Magnesium Phosphate or TNN Industries 'Formula 1', or equivalent is ideal. The application of fertiliser should be restricted to a maximum of twice a year

C. Drainage Tasks

Perforated Pipe	Ensure that perforated pipes are not blocked to prevent filter media and plants from becoming waterlogged. A small steady clear flow of water may be observed discharging from the perforated pipe at its connection into the downstream pit some hours after rainfall. Note that smaller rainfall events after dry weather may be completely absorbed by the filter media and not result in flow. Remote camera (eg CCTV) inspection of pipelines for blockage and structural integrity could be useful. Flushing of lines from the flushing points may be required. Frequency – 6 monthly after rain
High flow inlet pits, overflow pits and other stormwater junction pits	Ensure inflow areas and grates over pits are clear of litter and debris and in good and safe condition. A blocked grate would cause nuisance flooding of adjoining areas. Inspect for dislodged or damaged pit covers and ensure general structural integrity. Remove sediment from pits and entry sites (likely to be an irregular occurrence in mature catchment). Frequency – monthly and occasionally after rain

APPENDIX D: TREATMENT TRAIN OPTIMISATION RESULTS

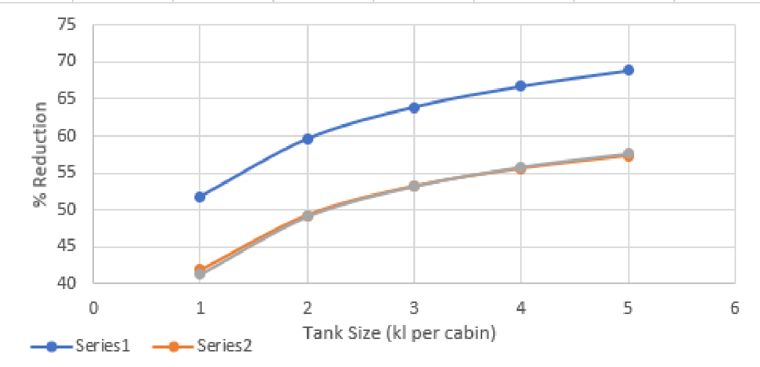
The oversizing of treatment measures in pursuit of improved modelling results can result in impractically expensive or nonfunctional assets that can in practice end up with a result that may be as bad or worse than doing no treatment at all. The purpose of undertaking a sensitivity analysis is to determine at what point the cost of continued upsizing treatment measures becomes disproportionate to the additional performance achieved – i.e. to optimise the water quality treatment solutions for the site.

D.1 Rainwater tanks – While the adopted 2kl tank storage for each 50sq.m cabin might be considered oversized compared to the configuration of a standard residential dwelling, it is considered that this is a practical economic size financially to take advantage of the tank installations (noting that pump costs, power costs and plumbing costs do not increase with tank size, and the tank cost rises only marginally with size at these small volumes).

A series of model runs was performed while varying only the rainwater tank sizes. The results (measured at the rainwater tank nodes) are presented below;

Cabin Rainwater tank sensitivity test - tank effectiveness
Roof area = 130 x 50sq.m cabins = 6500sq.m
Reuse = 0.1kl/day/cabin x 130 cabins

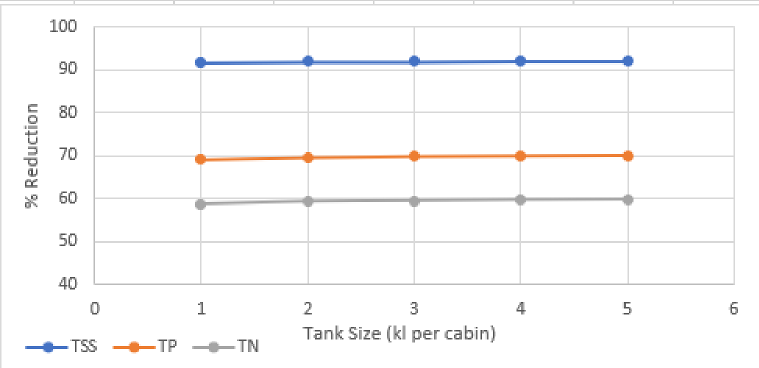
	% Reduction		
Tank Size x130 (kl)	TSS	TP	TN
1	51.8	41.9	41.3
2	59.6	49.3	49.1
3	63.9	53.2	53.2
4	66.7	55.6	55.8
5	68.8	57.3	57.6



To give an indication of the impact the rainwater tanks have on the overall site results, the charts displayed below same series of model runs with the results recorded from the overall site ‘post-development’ node.

Cabin Rainwater tank sensitivity test
Roof area = 130 x 50sq.m cabins = 6500sq.m
Reuse = 0.1kl/day/cabin x 130 cabins

	% Reduction		
Tank Size x130 (kl)	TSS	TP	TN
1	91.8	69.2	58.7
2	91.9	69.6	59.3
3	91.9	69.8	59.5
4	92	69.9	59.7
5	92	70	59.8

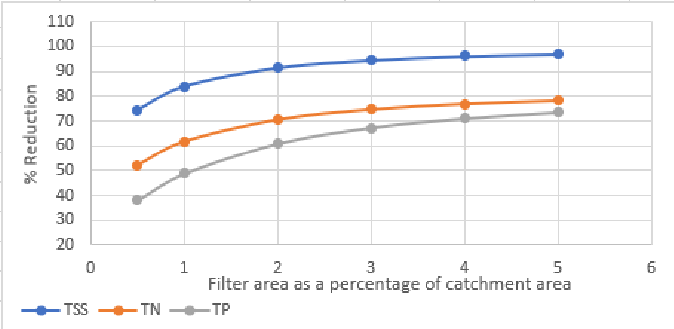


Conclusion – Due mostly to the fact the roof areas will make up such a small component of the overall site area (0.74ha/15.55ha = 8.2%), and that roof areas are comparatively clean compared to other urban landuses, the sizing of rainwater tanks is largely irrelevant to the overall site results. It could even be argued that it is not justified including them at all. However, as the proponent is intending on installing tanks to be consistent with the character of the development, it is considered appropriate to propose a 2kl per cabin installed on all short-term sites that a cabin is installed on.

D.2 Raingardens – Another series of model runs was performed while varying only the raingarden sizes (filter and storage areas). Tank sizes were set per the adopted values noted above. The results, measured at the bioretention node and ultimate site outlet node, are presented below;

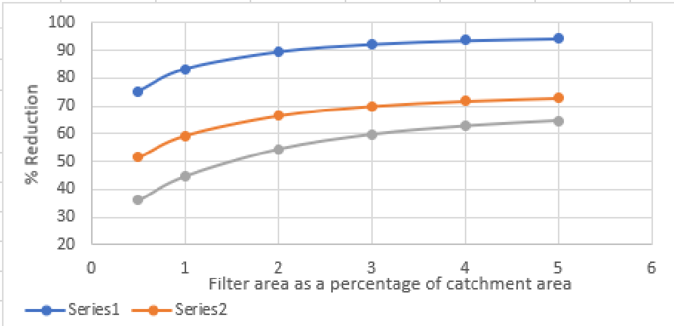
Raingarden area Sensitivity test - at Raingarden node
Catchment area 1 = 76,180sq.m impervious road area

Filter area (% of catchment)	% Reduction TSS	TN	TP
0.5	74.3	52.3	38.2
1	84	61.8	48.8
2	91.5	70.6	60.9
3	94.5	74.7	67.3
4	96.1	76.9	71
5	96.9	78.2	73.4



Raingarden area Sensitivity test - overall site impacts
Catchment area 1 = 76,180sq.m impervious road area

Filter area (% of catchment)	% Reduction TSS	TN	TP
0.5	75.2	51.6	36.1
1	83.3	59.4	44.8
2	89.5	66.5	54.5
3	92.2	69.9	59.8
4	93.5	71.7	62.8
5	94.2	72.8	64.7



Conclusion – Review of the results of the sensitivity test show it is reasonable to adopt a raingarden filter area size based on 3% of the contributing catchment area, which is generally consistent with experience on other developments. Modelling-wise, it does not matter if this is achieved as a single large raingarden, or at the other end of the scale, individual raingardens attached to each cabin. In order to find the right balance between functionality and practicality (from design, construction and maintenance perspectives), a series of larger raingardens has been proposed, distributed around the site as dictated by topography.